Sacher Lasertechnik Group

Pilot PC-OEM Laser Driver

User Manual

http://www.sacher-laser.com

Warranty

This Sacher Lasertechnik[Group] product is warranted against defects in materials and workmanship for a period of three years from date of shipment.
Duration and conditions of warranty for this product may be superceded when the product is integrated into (becomes a part of)other Sacher Sacher Lasertechnik[Group] products. During the warranty period, Sacher Lasertechnik[Group] will, at its option, either repair or replace products which prove to be defective.
The warranty period begins on the date of delivery or on the date of installation if installed by Sacher Lasertechnik[Group].

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For quickest response ask for 'Technical Support' and have your model and serial number available. Support is available by:

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General Information

General Description

The PilotPC Laser Driver is a highly precise controller for laser diodes. The laser current or the optical output power and the temperature of the connected laser diode can be precisely regulated.

The laser driver is managed by a modern 16 Bit ucontroller with internal flash memory. It is possible to update the firmware of the driver.
The main focus, when designing the driver, was, to give the customer a low noise laser driver with maximum safety for user and laserdiode.
The output power stage of the laser driver is designed in a low noise power supply technology.
This causes some more thermal power losses and makes in case of a high output current a external heatsink necessary.
The PilotPC power stage is a further development of our previous design which is working since more then 10 years in Sacher Lasertechnik products. So we are sure to give you a high quality and well approved instrument.

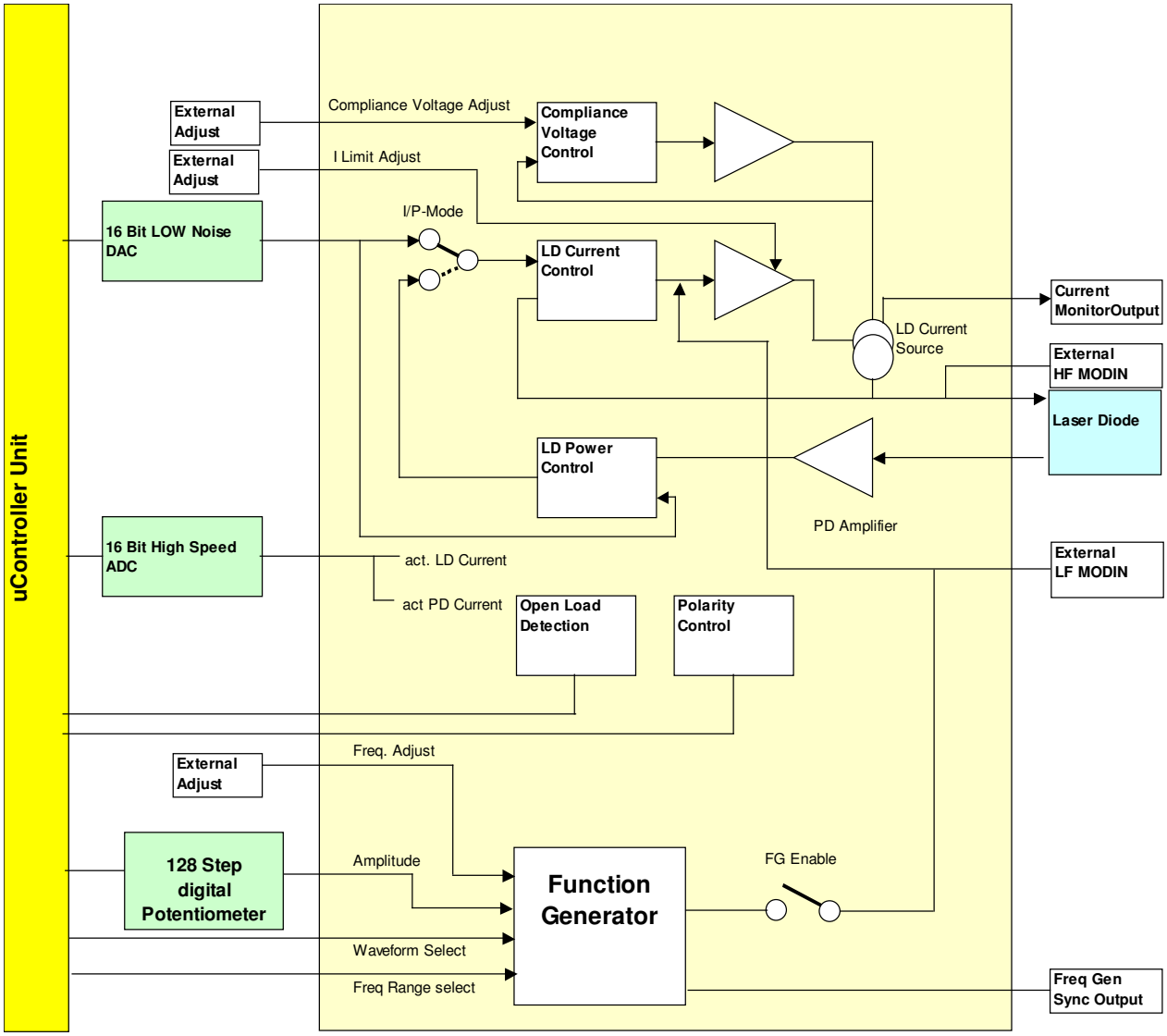
For automated control, a RS232 interface allows remote programming and readout from personal computers.In addition instrument drivers are available free upon request.

The PilotPC incorporates proven laser protection features, including exclusive clamping current limits, output shorting circuits and slow-start turn-on.

Block Diagram

Simplified Laser Current Control Block Diagram

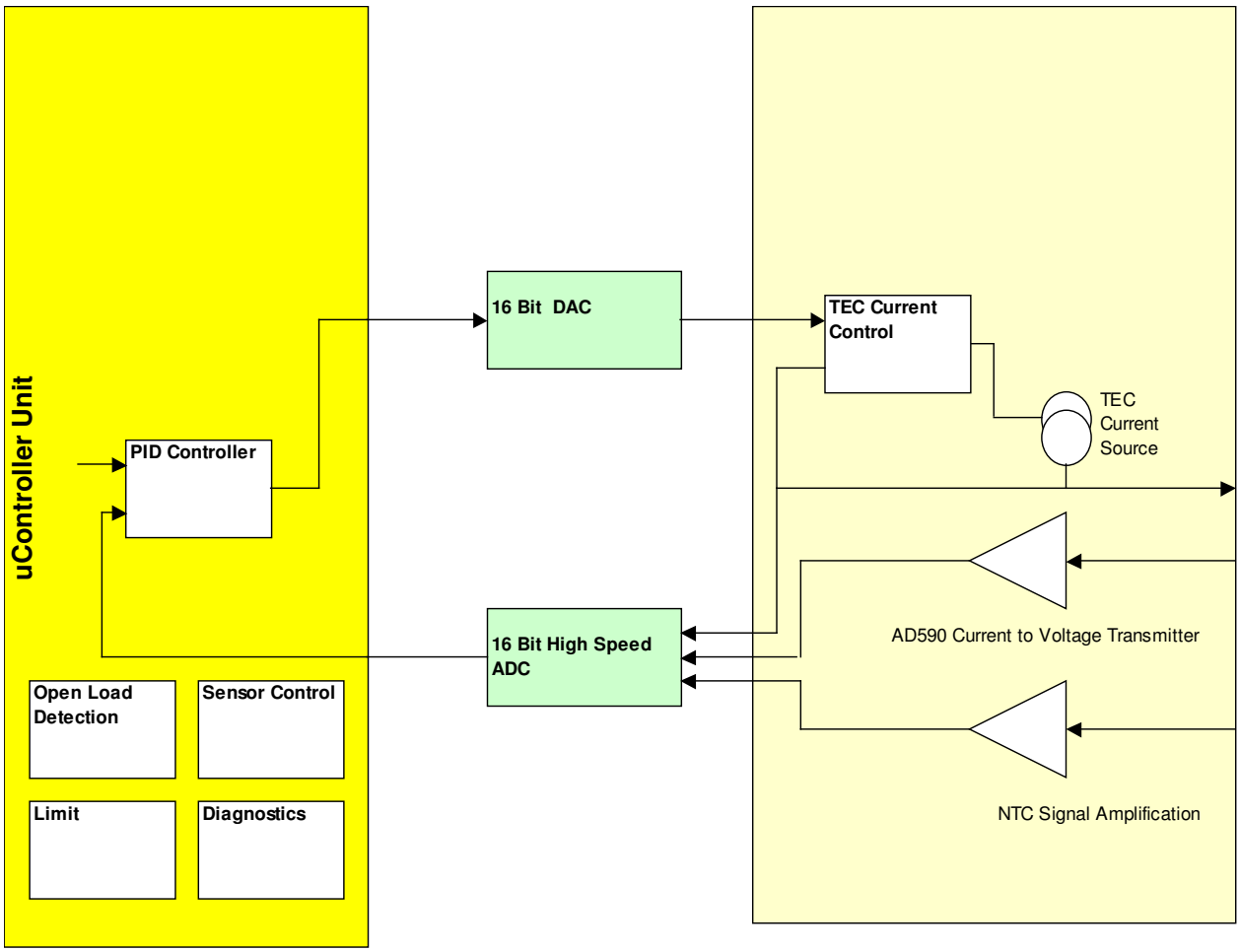
As shown in the block diagram the laser current source is controlled by the uController. Current control loop and power control loop is build in hardware. Only the set values are given by special DAC units. The uController also has several supervising functions like
- Diagnostic
- Monitoring
- Protection



Simplified Temperature Control Block Diagram

The main temperature control blocks are build in software.
This has some advantages for the user.
- free programmable PID Setup
- free programmable current limit

Also some diagnostic features are implemented to protect the laser diode
- Open load detection of TEC
- Bad heat sink detection
- temp watch window supervising
- Open/ short circuit detection in sensor lines

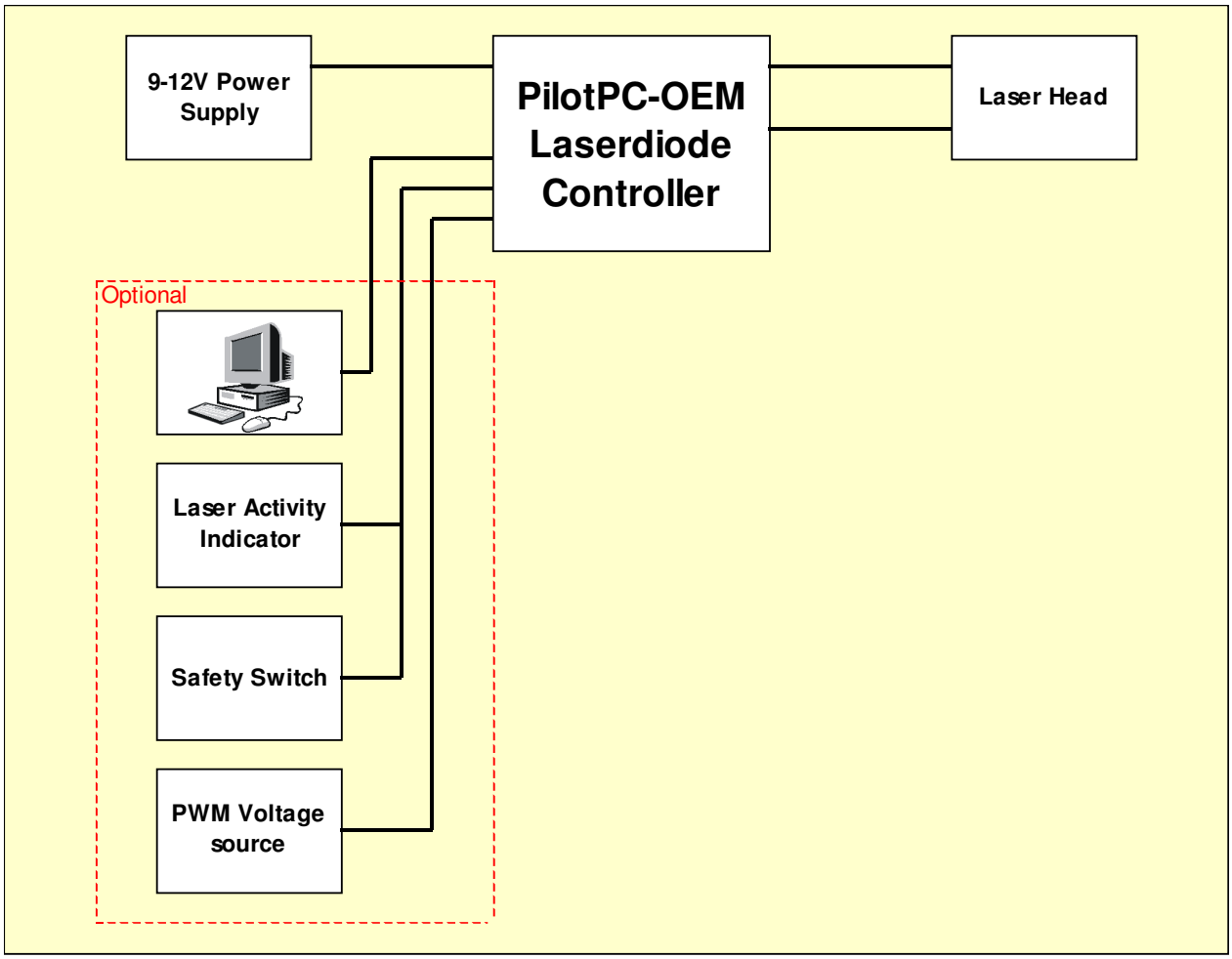


Getting Started

System Setup

The laser system consists of an electronic controller unit – the PilotPC OEM – and an external laser head. This configuration allows flexible use of the laser system possible since the laser head can be positioned freely in an optical setup.
Laser and controller are connected by two cables.This modular design enables you to switch wavelengths simply by changing the laser head (heads are available separately).

The system could be extended by external components such as
- PC with RS232 Interface
- Laser Activity Indicator
- Safety Switch
- PWM Voltage Source



Main Settings Laser

Before switching on the laser the right settings should be found and stored in the driver unit. This could be done over the RS232 Interface or by adjusting the external trim potentiometer on the rear side.
For an easy handling an ASCII protocol is implemented in the driver, so that the user could use a general purpose terminal program to communicate with the driver.

The settings are classified under System , Laser-Current Source and Temperature Controller.

The most important settings are:

Laser Current Source Settings

Laserdiode Polarity	See chapter "Laser Diode Connection"	RS232
Laserdiode Current Limit		External potentiometer
Laserdiode Operation Current		RS232
Laserdriver Mode	Driver could work in Const current or const power mode (only in case of an internal PD)	RS232

Temperature Controller Settings

Temperature Operation Point		RS232
Temperature Sensor	10KNTC or AD590	RS232
Temperature Controller PID Parameters		RS232
TEC Maximum Current		RS232
TEC Polarity		RS232

A complete summary of all settings is described in chapter "Settings and Measurements".

Prepare the Laser System for Use

1.Connect the laser cord

2.Connect the TEC cord

3.Connect the power cord with your power supply

4.The “TEC Indicator” light will be ON

4.The “Error Indicator” light will be OFF

5. Press the “Laser ON” Button

6. The “Laser Indicator Light” will blink

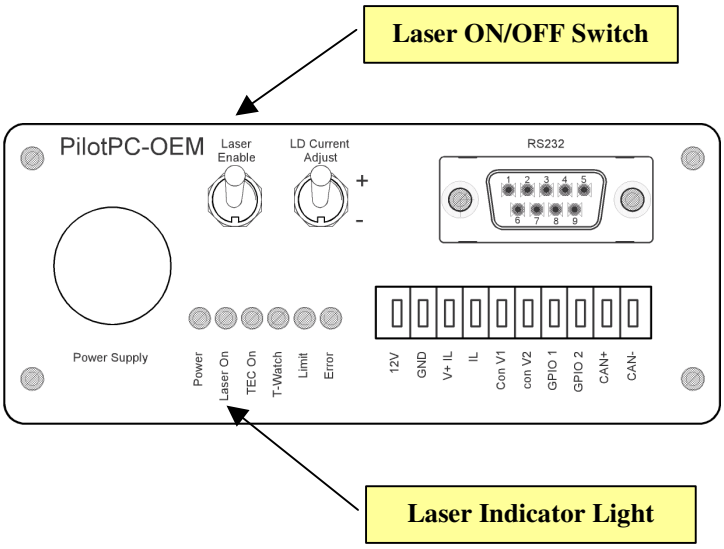
7. When the current is reached the system will beep

8. The “Laser Indicator Light” will be ON

Before switching on the laser the right settings should be found and stored in the driver unit. This could only be done over the RS232 Interface.

Turn the Laser On / Off

The laser could be turned ON by 3 different ways
- Pressing the “Laser ON/OFF” Button on the front side.
- High Transition Signal on PWM Port
- “Laser ON” Command over RS323



Laser Diode Connection

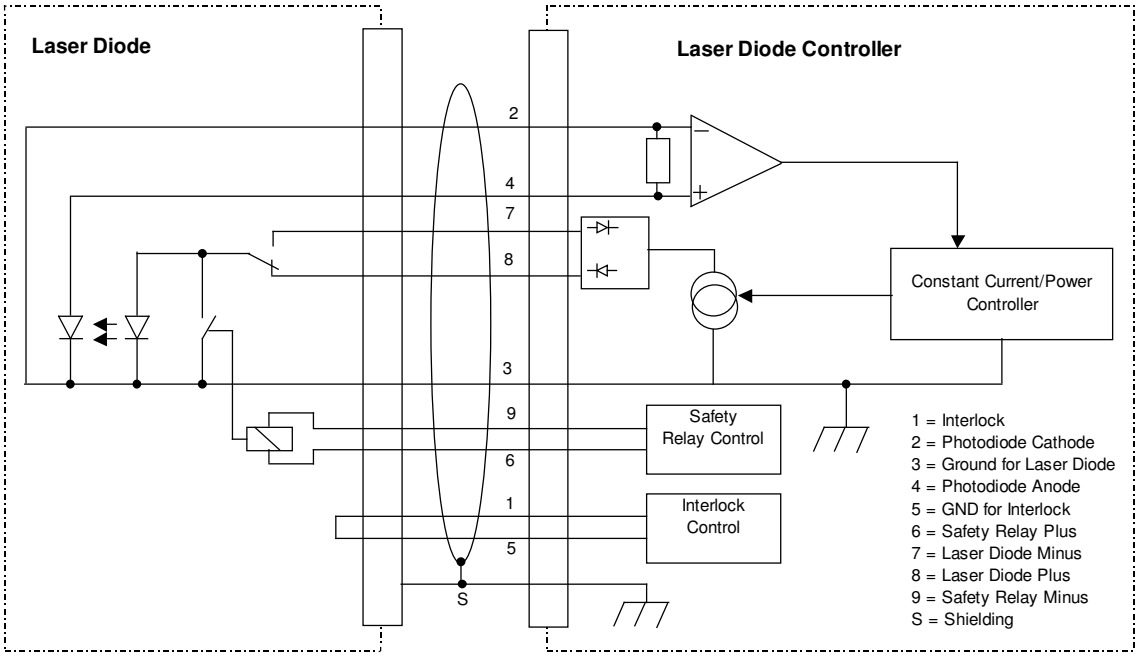
The laser diode is connected over the “LASER CONNECTOR” on the rear panel of the driver. To get the full performance and safety please only connect a special laser head from *Sacher Lasertechnik*.
These *Sacher Lasertechnik* laser heads incorporate several features.

- Short circuit relay for the laser diode
- Input filter network for current transient protection
- Interlock loop
- bias-T option for high frequency modulation
- separate calibrated photodiode for const power mode (only for high power TIGER systems)

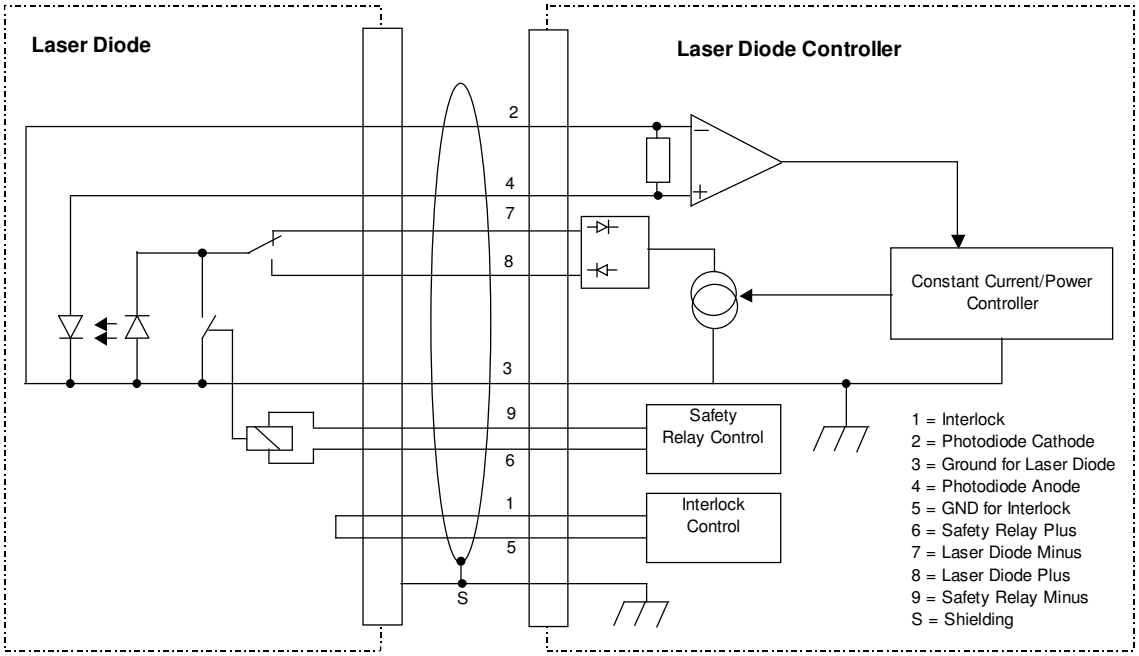
Laser Diode/ Photodiode Polarity

For maximum flexibility and laser safety the driver supports 4 different laser diode configurations which are shown in the following schematics.

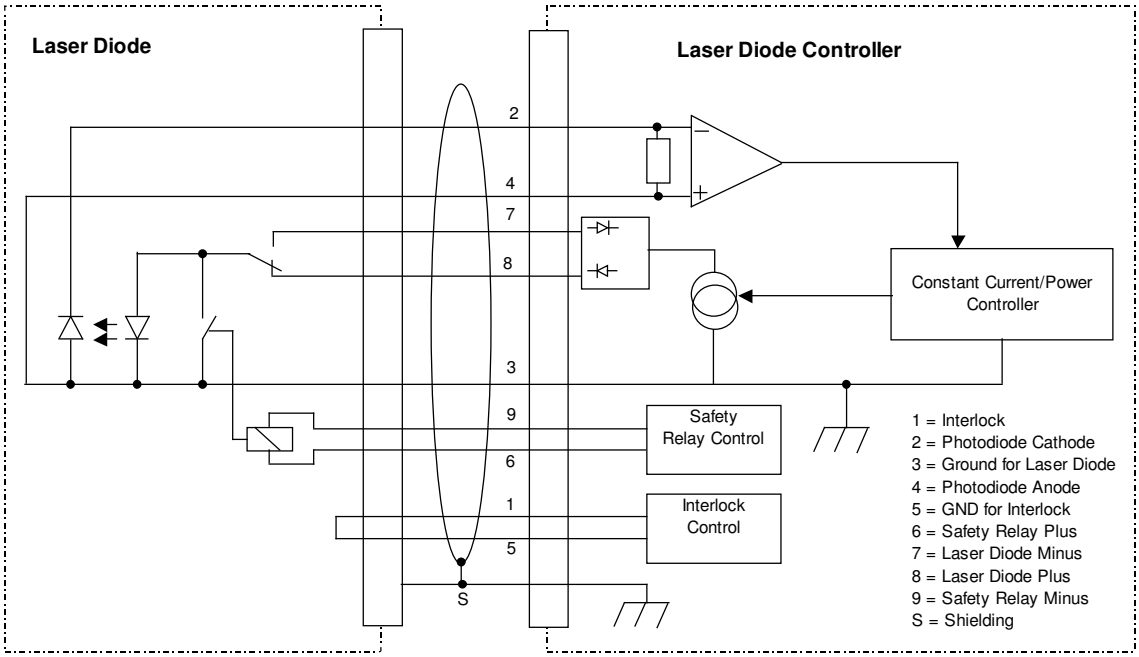
Configuration 1 (common cathode)



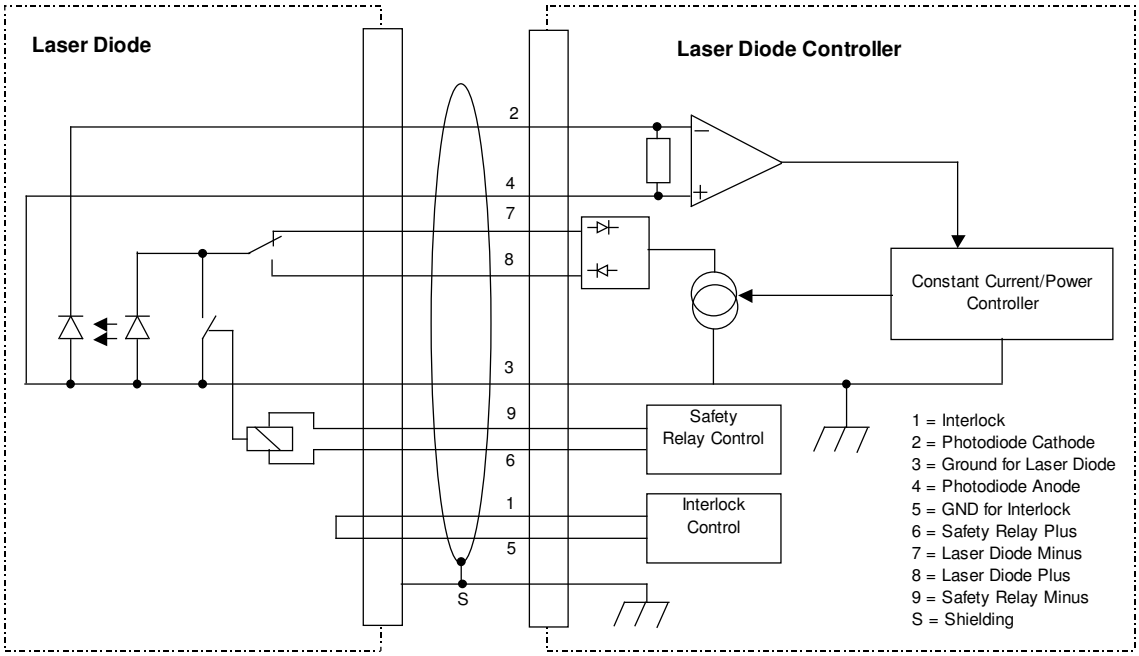
Configuration 2



Configuration 3



Configuration 4 (common anode)



The following list gives you the correct polarity setting.

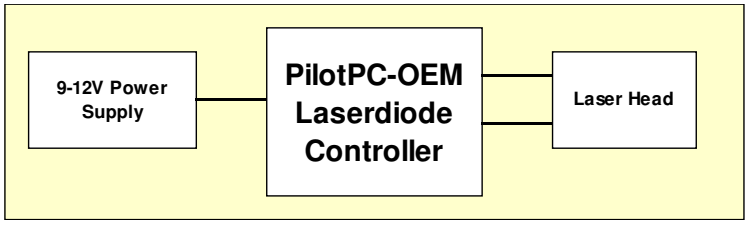
Configuration	**Polarity**
Configuration 1 (common cathode)	Positive
Configuration 2	Negative
Configuration 3	Positive
Configuration 4 (common anode)	Negative

Connection to Ground

Ground free Operation

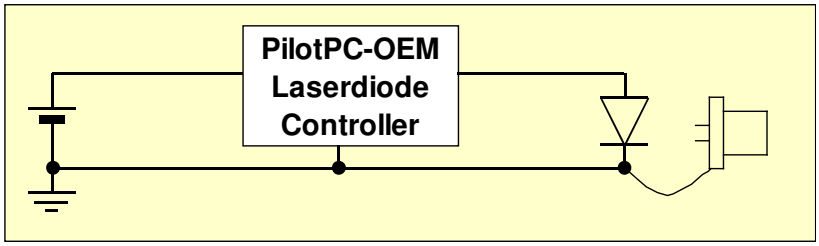
RS232 and PWM Port has differential or optically decoupled inputs so that ground free operation is possible when the external 9-12V power supply is not connected to ground.

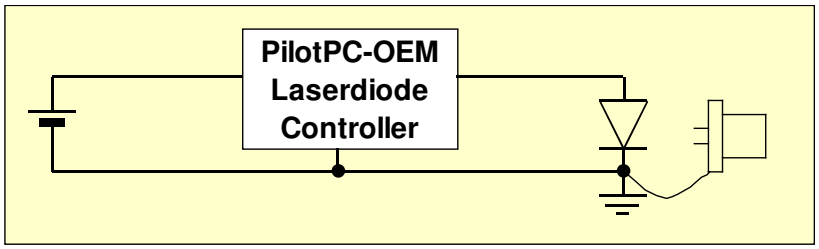
Note: The maximum ground differential voltage from the RS232 interface is 50V.

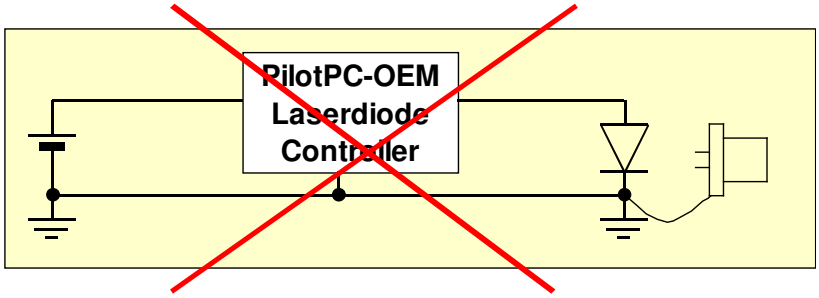


LD-Operation with Connection to Ground

Laserdiode or power supply could have a connection to ground.
Several setups are possible.
In case of low noise current requirements double ground connection should be avoided.
The two different polarity settings ensure that the laserdiode housing is connected internally to ground.







TEC / Temperature Sensor Configurations

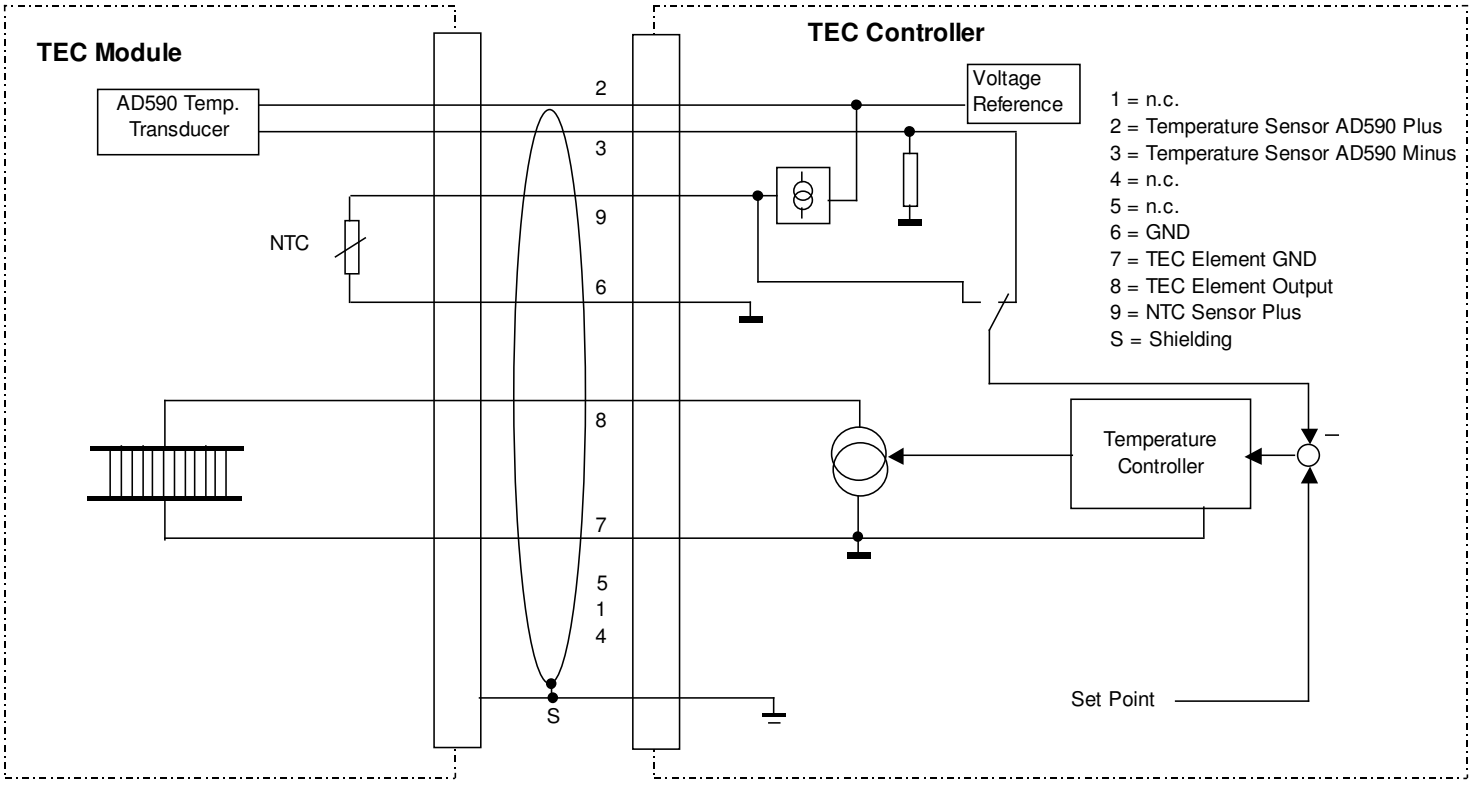
TEC and temperature sensor are connected over the “TEC CONNECTOR” on the rear panel.

The laser driver supports two different types of sensors.
- AD590 (Temperature Transducer)
- 10K NTC (Thermistor)

The sensor type could be selected in the “Temp Setup Menu”

For best operation of the temperature controller the right PID Settings must be found. This could be done by testing or calculating the TEC and laser head behaviour.
For testing and qualifying the heating / cooling process the laserdriver provides test functions where the user easily could calculate process response time and amplification.
The temperature controller is internal realized as a PID controller, so the user has to setup 3 parameters.

TEC Configuration



Settings and Measurements

This chapter lists all settings and measurements which could be done over the RS232 interface. Every setting must be explicit saved to be present after system shut down.
You will find the detailed description of all commands in the "Programming Manual".

Laserdiode Current Source

Settings

Laser Polarity	Anode Grounded /Cathode Grounded
Laser Current Limit	
Current Source Compliance Voltage	Important for open load detection
Driver Mode	Const. current or const. power mode
Laser Status	ON / OFF
Laser Cable Resistance	(important for Laserdiode voltage measurements)
Laserdiode Current	
Photdiode Current	
Photodiode/Power Calibration Table	
PWM Voltage Port Mode	PWM-Mode ; ON/OFF-Mode; Disable

Note: All Settings could be read back

Measurements

Laserdiode current	
Photodiode current	
Calculated Laser Power	
Laserdiode Voltage	
Laserdiode working hours	

Temperature Controller

Settings

Temperature Sensor	10K NTC or AD590
PID Settings	P,I,D
TEC Polarity	
Temperature operation point	
TEC Current Limit	
Temperature Controller	ON / OFF
TEMP Watch status	ON / OFF
TEMP Watch window	

Note: All Settings could be read back

Measurements

Temperature	
TEC current	
TEC voltage	
TEMP Watch Status	

System

Settings

User Settings	Different Settings could be stored or recalled
RS232 Baudrate	
RS232 Echo	ON / OFF
System Beeper	ON / OFF
System Boot	Used when Firmware Update is necessary

Note: All Settings could be read back

Measurements

System Identification	Contains Driver name, Serial number, Software Version
Error Code	Gives an error code in case of implausible values
System Working hours	

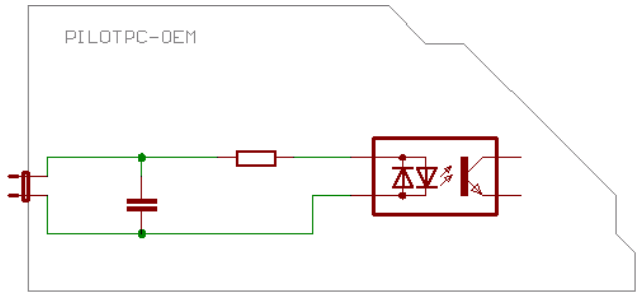
Service Port Operation

PWM Voltage Port

The “PWM Voltage Port” is used to switch the laser ON and OFF or adjust the laser current/power. The port could also be disabled.

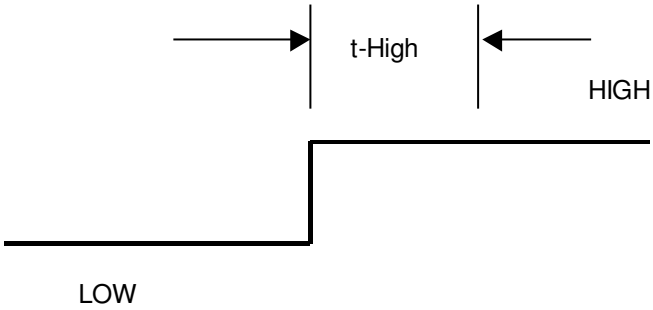
Internal circuit

To avoid ground loops and disturbance the input port is optically coupled and not polarity sensitive.



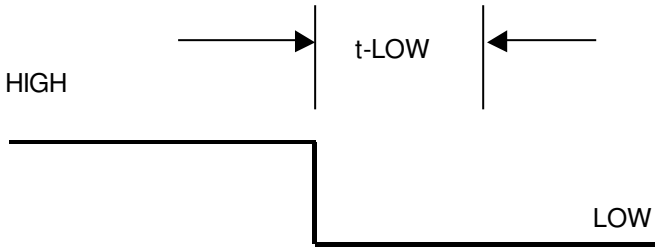
PWM ON /OFF Mode

To switch the Laser ON the following sequence must be present at the port.



The minimum high time must be 10ms

To switch the laser OFF the following sequence must be present at the port.



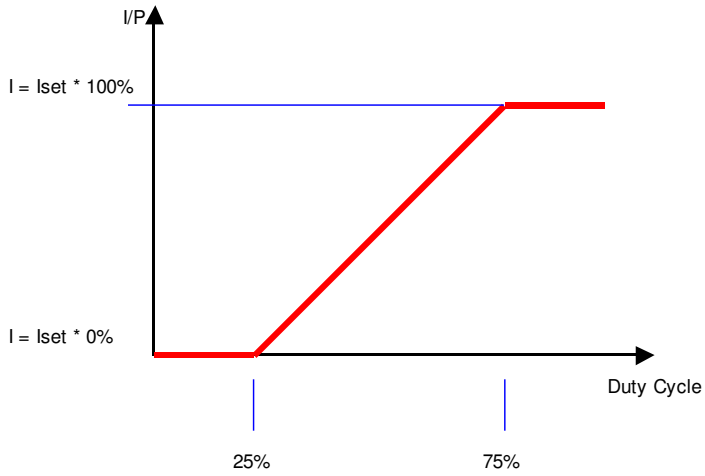
The minimum low time must be 10ms

PWM Adjust Mode

To adjust the laser current or laser power (in const. power mode) a PWM (pulsewith modulated signal) must be connected at the port.

The laser current/power could be adjusted with the following transfer function.

Operation Value = Max-Value * (Duty Cycle – 25%) * 2



Interlock Port

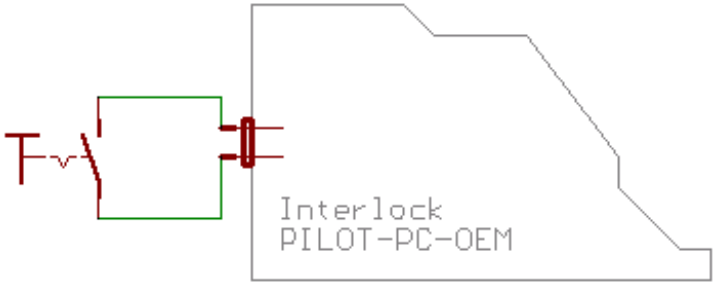
The interlock port is one of several safety features.

The port acts as input port for a safety contact and as an indicator port which could drive a LED.

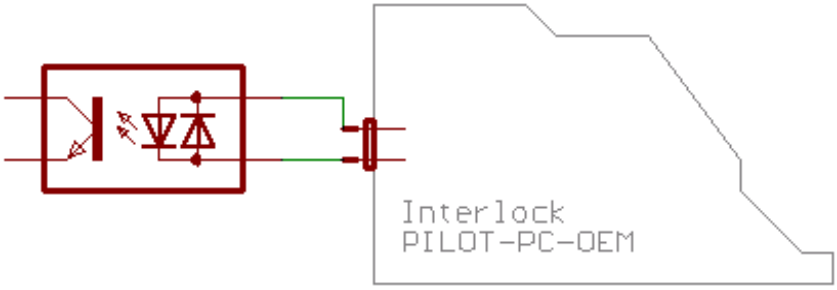
The port is internally hardwired to the laser power supply so that an open interlock loop will directly cause a shut down of the laser.

Possible Interlock Configurations

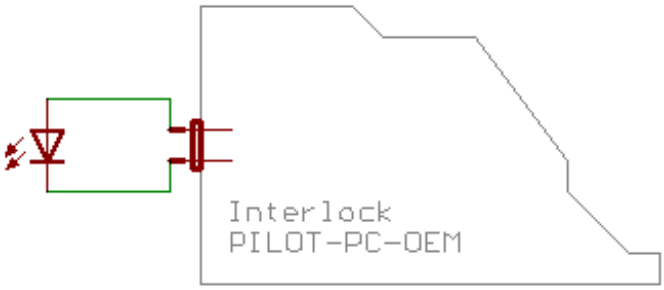
Safety Swich



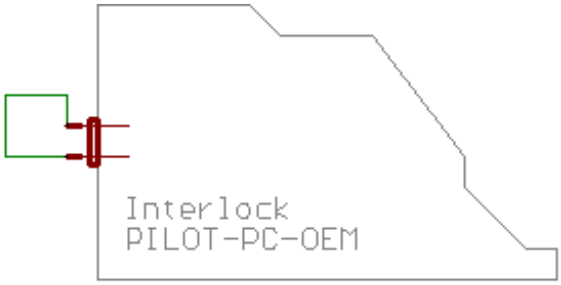
Optical coupled Output



Indicator LED



Interlock Disabled

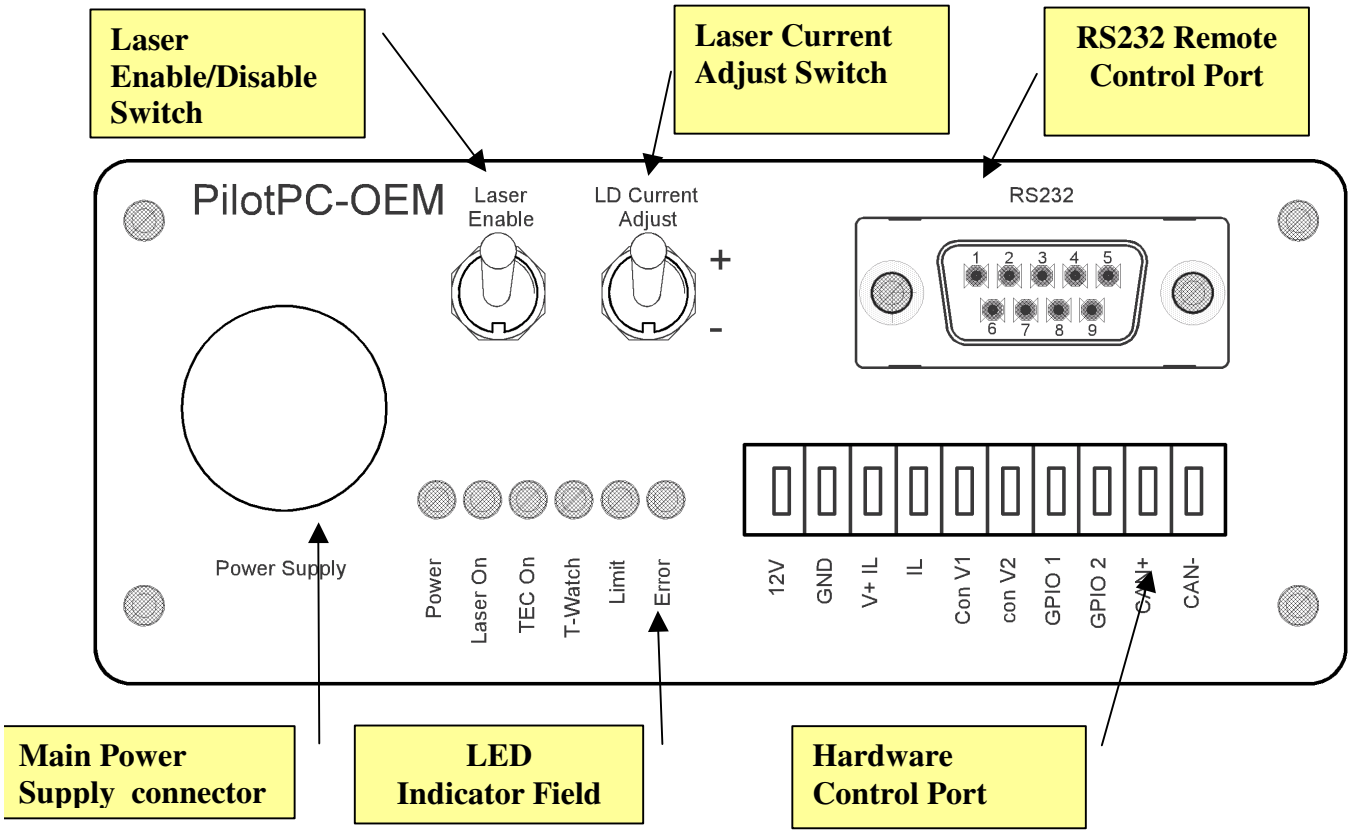


Housing Description

(Butterfly Version)

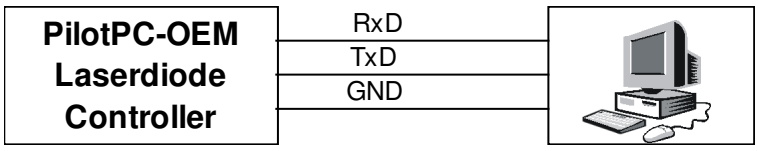
Front Side Elements

This chapter describe each control and connector on the laserdriver front side.



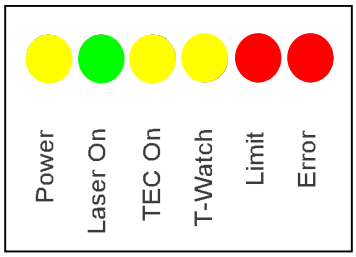
RS232 Remote Control Port

9pol SUBD connector for a one to one cable connection to a PC.



GND Signal is isolated against power supply ground.
The status lines of the serial port are not used.

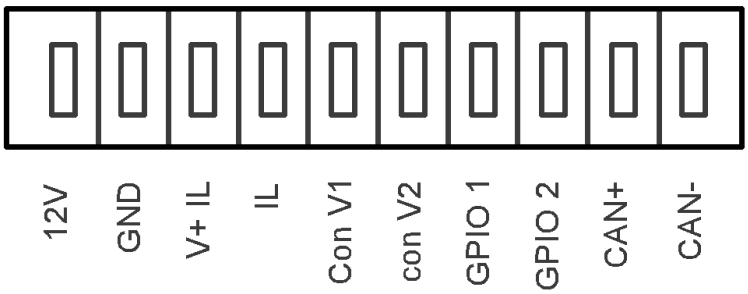
LED Indicator Field



Laser ON / OFF Swich
The laser is switched ON/OFF by pressing the button.
The button light indicates the laser status.
Light OFF -> Laser OFF
Light Blinking -> Laser in startup
Light ON -> Laser ON

Laser Current Adjust Swich
The laser is switched ON/OFF by pressing the button.
The button light indicates the laser status.
Light OFF -> Laser OFF
Light Blinking -> Laser in startup

Hardware Control Port



PWM Voltage Port: Is used to switch on the laser or adjust the curren/power level with a digital signal.
See am more detailed description in chapter “PWM ON /OFF Mode.

Interlock: Port: Is used to connect a external safety switch.

Indicator LED Field

T-Watch LED

LED OFF	T- Watch function disabled
LED ON	T-Watch function is active. (Laser operation enabled)
LED Blinking	T-Watch function is active. Temperature is out of window (Laser operation is disabled)

TEC LED

LED OFF	Temperature Controller disabled
LED ON	Temperature Controller enabled TEC active
LED Blinking	

Error LED

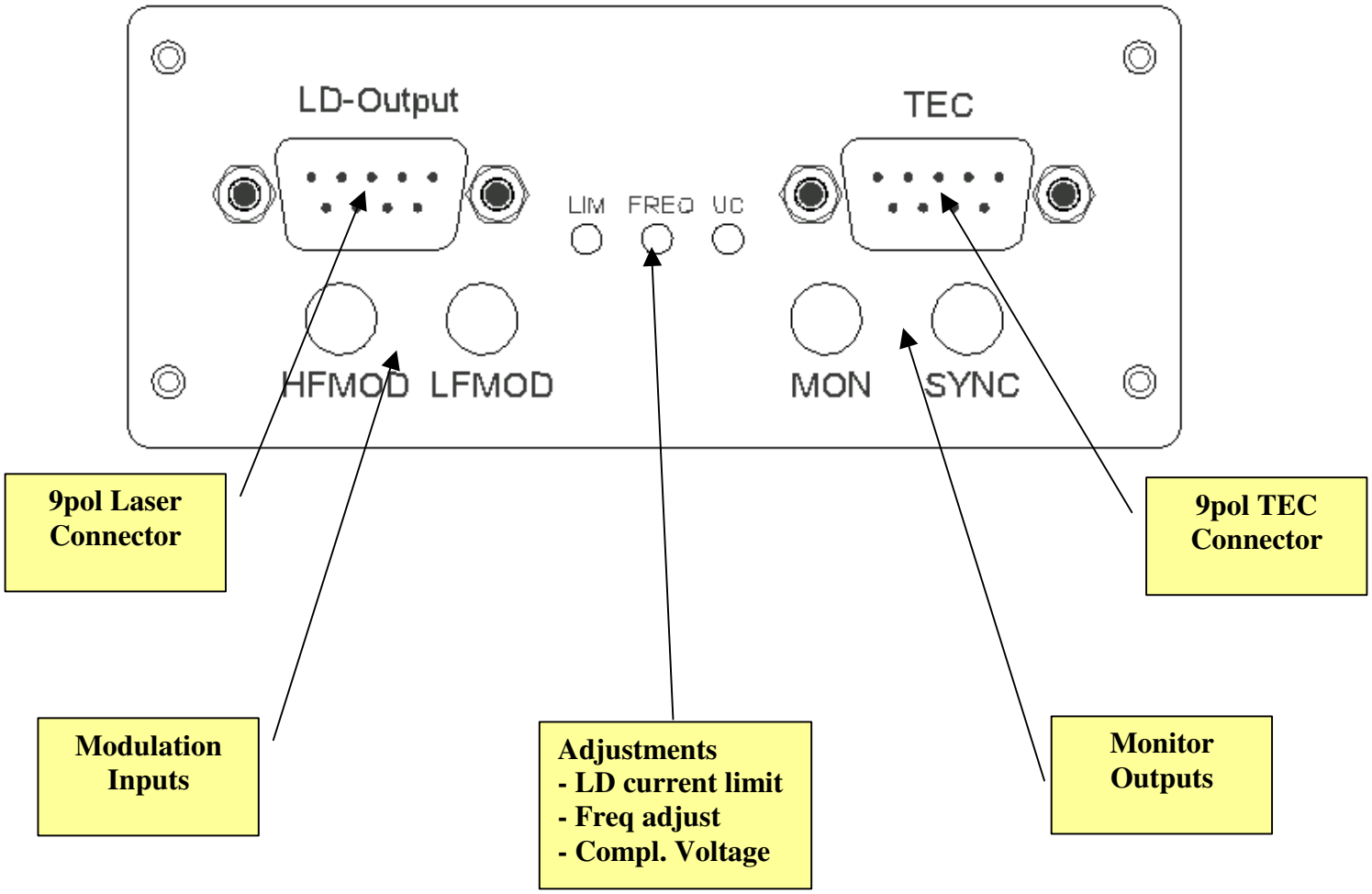
LED OFF	No error
LED ON	Error appeared
LED Blinking	RS232 Command Error

Power Supply Connector

5pol DIN connector for an external power supply.

Rear Side Elements

This section shows the rear panel elements.
On this side you find all connectors to the laser head (LD-Output, TEC) .



Beeper Control

The bepper acts as acoustical warning when the laser is turned on and as error indicator.
Error beeper messages could be deactivated in the SYSTEM SETTINGS or over remote interface.

The following table explains the different cases.

Action	**Beeper sound**	**Could not be deactivated**
Laser delay count	50ms every second	X
Laser on	50ms 3 times	X
Laser Current Limit reached	200ms 3 times	
Temperature not reached	5ms 150 times	
Temp-Watch window true	10ms 2 times	
Driver Overtemperature	500ms 3 times	X
General fault	5ms 20 times	

Specifications

Laser Diode Controller

Current Source PilotPC-OEM 500

Drive Current Output

Output Current Range:	0-600mA
Setpoint Resolution:	0.1mA
Setpoint Accuracy:	±0.1% of FS
Noise:	<5µA RMS
Temperature Coefficient:	<50ppm/°C
Short-Term Stability (1 hr.):	<20ppm
Long-Term Stability (24 hr.):	<50ppm

Preregulator Voltage(Compl. Voltage)

Adjustable :	0-7V

Drive Current Limit Settings

Range:	1-600mA
Resolution:	0.1mA

Photodiode Feedback

Type:	Differential 100R Input
Photodiode Current Range :	0-5000µA Range 1
	0-500µA Range 2
	0-500µA Range 2 *[1]

*[1]This is a factory option and must be activated inside the driver.

Temperature Controller PilotPC-OEM 500

TEC Output

Output Type:	Constant Current Source Bridge
Compliance Voltage:	6V
Maximum Output Current:	-2A to 2A
Current Limit Setpoint Accuracy:	125uA
Maximum Power:	12W

Sensor

Temperature Sensor:	NTC or IC Temp Sensor AD590
Temp. Control Range :	0 to 55°C (AD590 and NTC)
Setpoint Resolution NTC:	0.001°C
Setpoint Resolution AD590:	0.001°C
Long Time Stability:	0.05°C
Thermistor Sensing Current:	100µA
Sensor Bias:	5V

NOTES
All values relate to a one-hour warm-up period.
Operating Temperature: 0°C to 40°C
Storage Temperature: –25°C to 70°C
Humidity: 20–85 %, non condensing

Current Source PilotPC-OEM 3000

Drive Current Output

Output Current Range:	0-3000mA
Setpoint Resolution:	1mA
Setpoint Accuracy:	±0.1% of FS
Noise:	<20µA RMS
Temperature Coefficient:	<50ppm/°C
Short-Term Stability (1 hr.):	<20ppm
Long-Term Stability (24 hr.):	<50ppm

Preregulator Voltage

Adjustable :	7V

Drive Current Limit Settings

Range:	1-3000mA
Resolution:	1mA

Photodiode Feedback

Type:	Differential 100R Input
Photodiode Current Range :	0-5000µA Range1 0-500µA Range 2 *[1]

*[1]This is a factory option and must be activated inside the driver.

Temperature Controller PilotPC-OEM 3000

TEC Output

Output Type:	Bipolar Constant Current Source
Compliance Voltage:	6V
Maximum Output Current:	-3A to 3A
Current Limit Setpoint Accuracy:	125uA
Maximum Power:	18W

Sensor

Temperature Sensor:	NTC or IC Temp Sensor AD590
Temp. Control Range :	0 to 55°C (AD590 and NTC)
Setpoint Resolution NTC:	0.001°C
Setpoint Resolution AD590:	0.001°C
Long Time Stability:	0.05°C
Thermistor Sensing Current:	100µA
Sensor Bias:	5V

Options

External Interlock

Threshold Voltage:	2V
ON Current :	t.b.d

PWM Port

Max. Low Voltage:	1V
Min. High Voltage:	4V
Frequency Range:	100Hz to5KHz *[1]
	*[1] min. Pulsewith 10µsec

Internal Function generator

Freq. Range :	100Hz ..10kHz
Amplitude:	10% of Fullrange adjustable 128steps
Waveform:	Sine and Triangle

LF DC Modulation Input

Amplification:	25mA/V PC500 125mA/V PC3000
3db Cutoff Frequency:	5kHz @ 5R Load

HF DC Modulation Input

Amplification:	1mA/V
3db Cutoff Frequency:	tbd

Power Supply

Input Voltage Range (Vin):	12V
Supply Current (Iin):	230mA + I_{Laser}+ I_{TEC}
Max. thermal dissipation loss:	t.b.d

Environmental Conditions

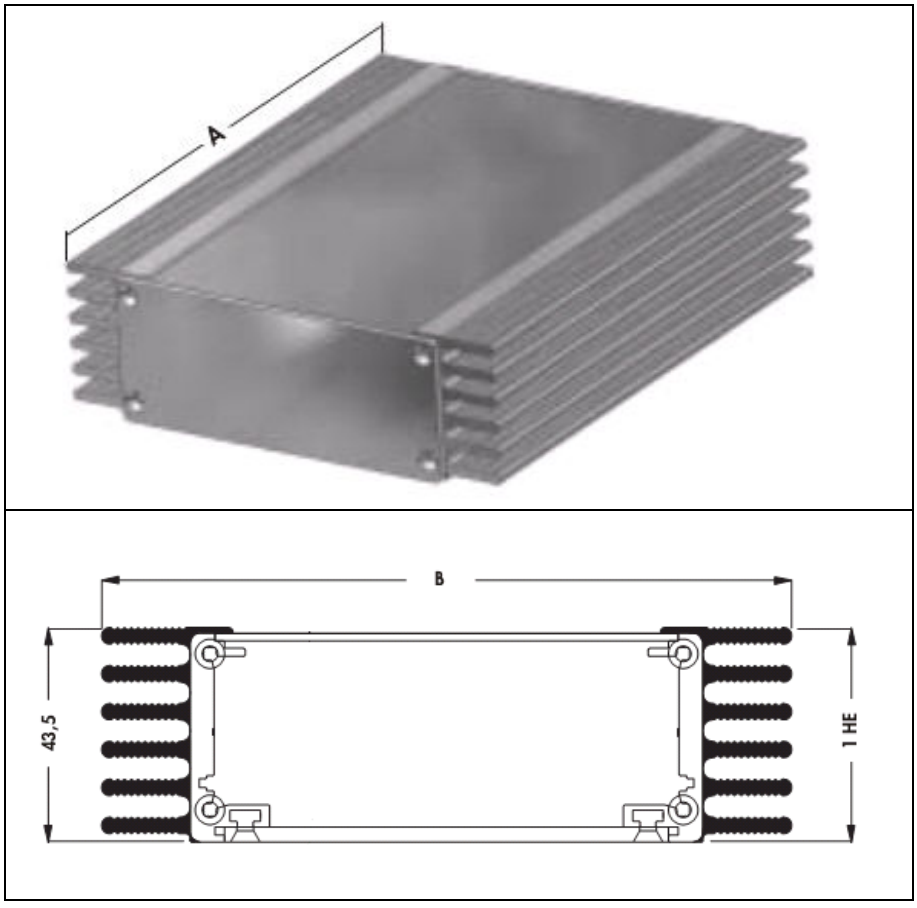
Operating Temperature:	0°C to 40°C *1
Storage Temperature:	–25°C to 70°C
Humidity:	20–85 %, non condensing

**1 Housing must be fixed on a heat sink with customer specific holders. The heat sink temperature should not exceed 40°C.*

Common Data

Dimensions

W x H x D: 166 x 140 x 43.5 mm



Weight

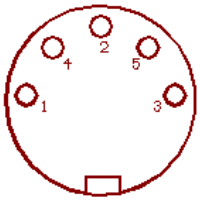
Weight :1200g

Appendix

Connector Schematics

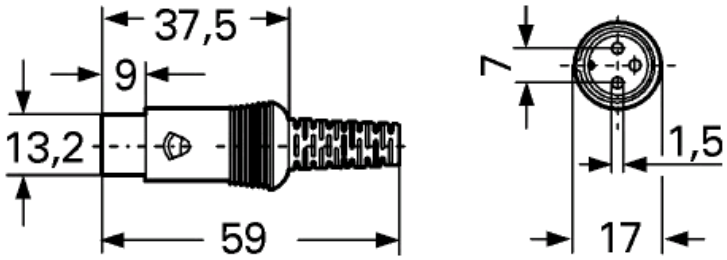
Power Supply Connector

5pol DIN connector for an external power supply



Pin Nr.	Signal Name	Description
1	GND Power	Ground Power Supply Input
2	GND Power	Ground Power Supply Input
3	12V Power Input	12V Power Supply Input
4	GND Power	Ground Power Supply Input
5	12V Power Input	12V Power Supply Input

Connector for power cord



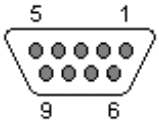
Ordering Information
Distributor: Buerklin
Ordering Code 70F212

US Sales Office
Buerklin Electronics USA, LLC
305 J Aspen Business Center
Aspen, Colorado 81611

Laser Connectors

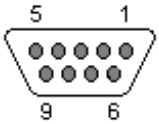
Laser Supply Cable to Laser Head (LD OUTPUT)

Standard Sub-D9 FEMALE 1:1 connection rated for 5A.
This connection is required.



Pin Nr.	Signal Name	Description
1	Interlock	
2	PD-	Photodiode Signal Minus
3	LD GND	Laser Diode Ground
4	PD+	Photodiode Signal Plus
5	Interlock	
6	REL+	Safety Relay Plus
7	LD-	
8	LD+	Laser Diode Plus
9	GND	

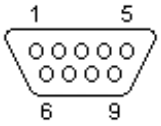
Laser Supply Cable to Laser Head Thorlabs LM14S2 Option



Pin Nr.	Signal Name	Description
1		Interlock
2	PD-	Photodiode Cathode
3	LD+	Laser Diode Anode
4	PD+	Photodiode Anode
5		Interlock
6		
7	LD GND	Laser Diode Cathode
8		
9		

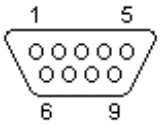
TEC Supply Cable to Laser Head (TEC OUTPUT)

Standard Sub-D9 MALE 1:1 connection rated for 5A. This connection is usually required, but optional if temperature control is not needed.



Pin Nr.	Signal Name	Description
1	MGND	
2	AD590+	Temperature Sensor
3	AD590-	Temperature Sensor
4		
5		
6	NTC	Temperature Sensor
7	TEC-GND	
8	TEC-OUT	Peltier Output
9	NTC	Temperature Sensor

TEC Supply Cable to Laser Head Thorlabs LM14S2 Option

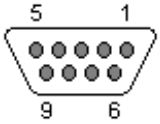


Pin Nr.	Signal Name	Description
1		
2	NTC	Temperature Sensor
3	NTC	Temperature Sensor
4	TEC-OUT	Peltier Output
5	TEC-GND	Peltier Ground
6		
7		
8		
9		

RS232 Connector

RS232 Remote Interface Connector

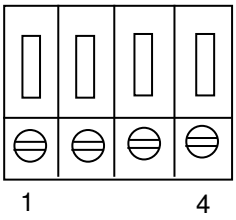
Standard Sub-D9 FEMALE connector.
This connection is only used for Remote Control.
Use a 1to1 cable for connection with a standard personal computer.



Pin Nr.	Signal Name	Description
1		
2	TxD Output	
3	RxD Input	
4		
5	GND	
6		
7		
8		
9		

Control Port Connector

This connection is used for an external safety switch laser-current/power control.

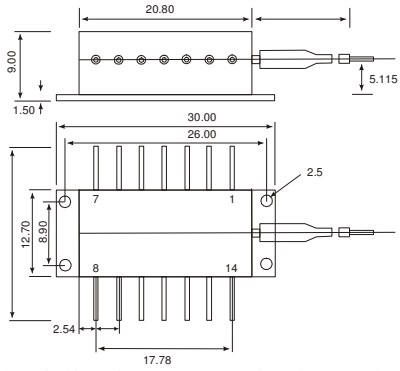


Pin Nr.	Signal Name	Description
1	V+	Supply Voltage interlock switch
2	Interlock	Interlock Signal
3	Control	Opt. isolated ON/OFF/PWM Input
4	Control	Opt. isolated ON/OFF/PWM Input

Internal Butterfly Laser Diode Connections

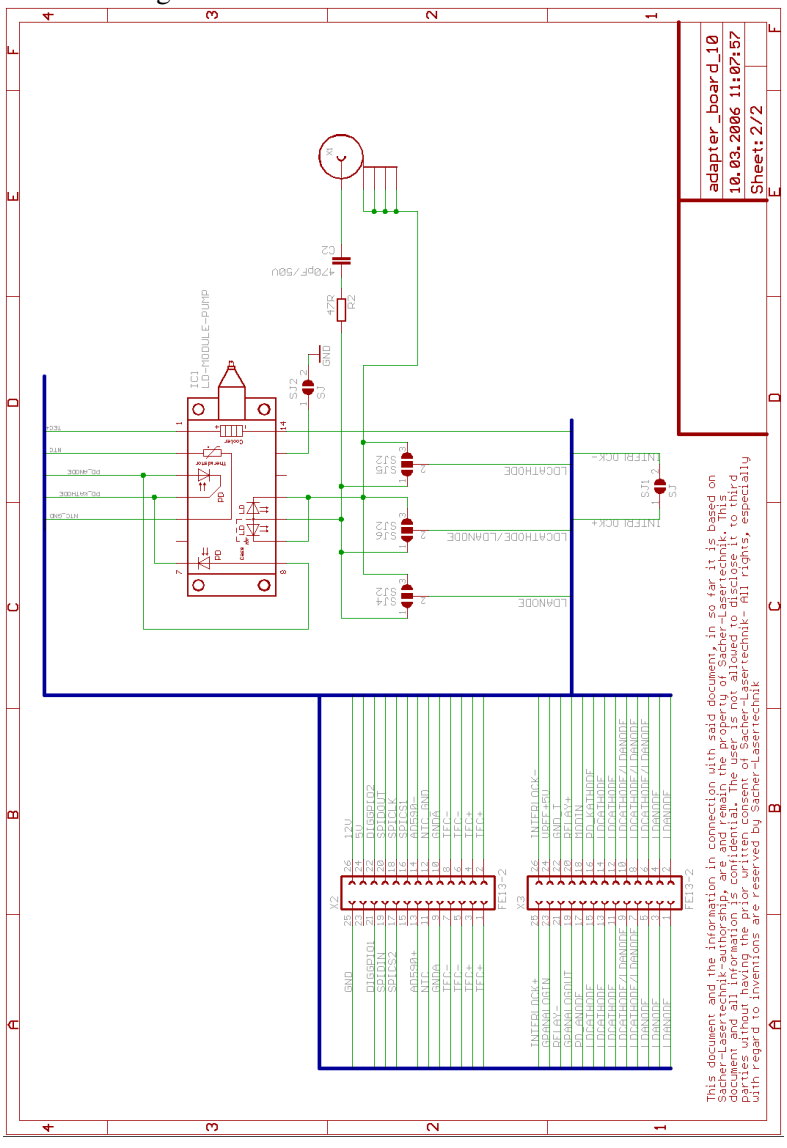
The OEM laser driver could be equipped with different adapter boards for 14pin butterfly laserdiodes

14pin Butterfly: Pump Laser Configuration

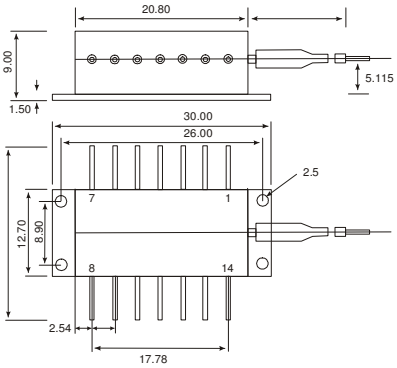


Pin 1:	Cooler +
Pin 2:	NTC
Pin 3:	PD Anode
Pin 4:	PD Kathode
Pin 5:	NTC
Pin 6:	n.c.
Pin 7:	PD Kathode
Pin 8:	PD Anode
Pin 9:	LD Kathode
Pin 10:	LD Anode
Pin 11:	LD Kathode
Pin 12:	n.c.
Pin 13:	Case Ground
Pin 14:	Cooler -

The following schematic shows the internal connection to the laserdiode

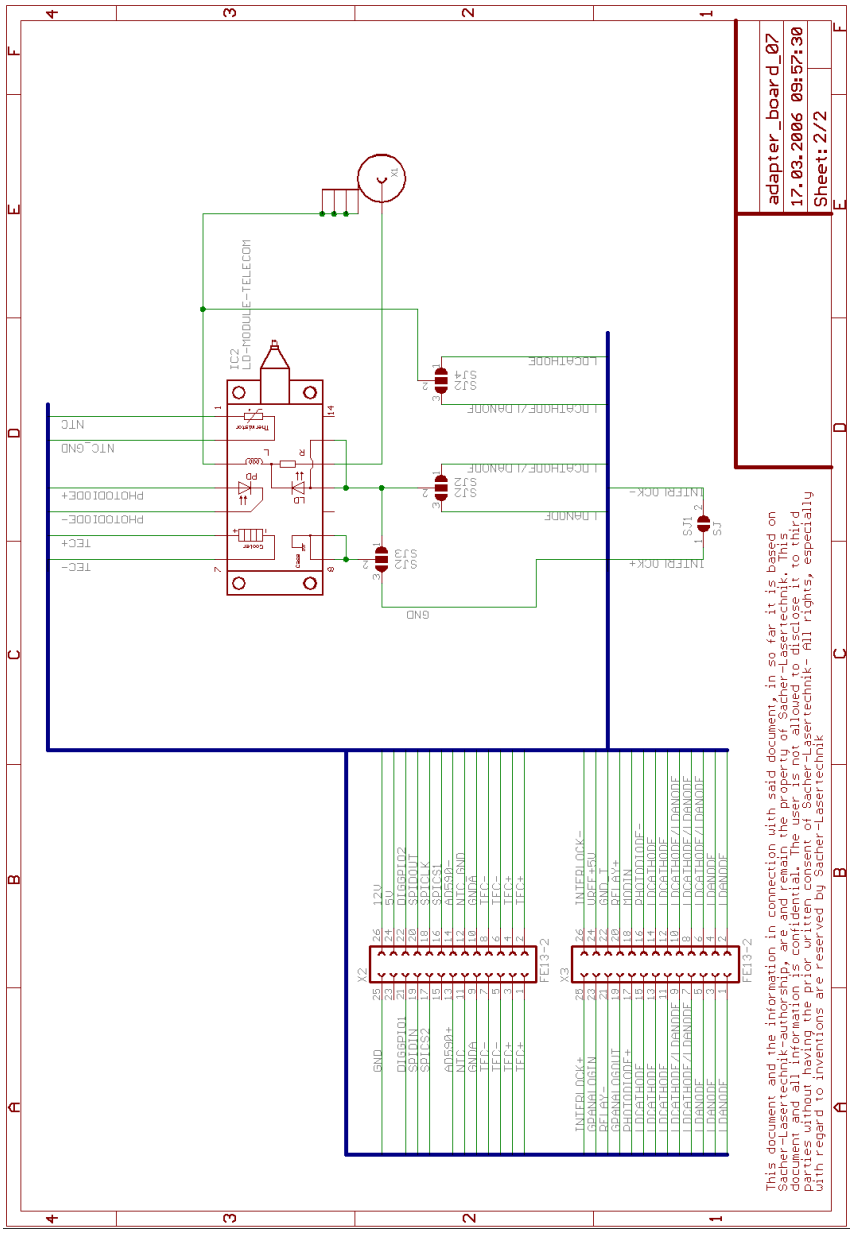

adapter_board_10
10.03.2006 11:07:57
Sheet: 2/2
LD-MODULE-PUMP
GND
LDCATHODE
LDANODE
INTERLOCK-
INTERLOCK+
This document and the information in connection with said document, in so far it is based on Sacher-Lasertechnik-authorship, are and remain the property of Sacher-Lasertechnik. This document and all information is confidential. The user is not allowed to disclose it to third parties without having the prior written consent of Sacher-Lasertechnik. All rights, especially with regard to inventions are reserved by Sacher-Lasertechnik

14pin Butterfly: Telekom Laser Configuration

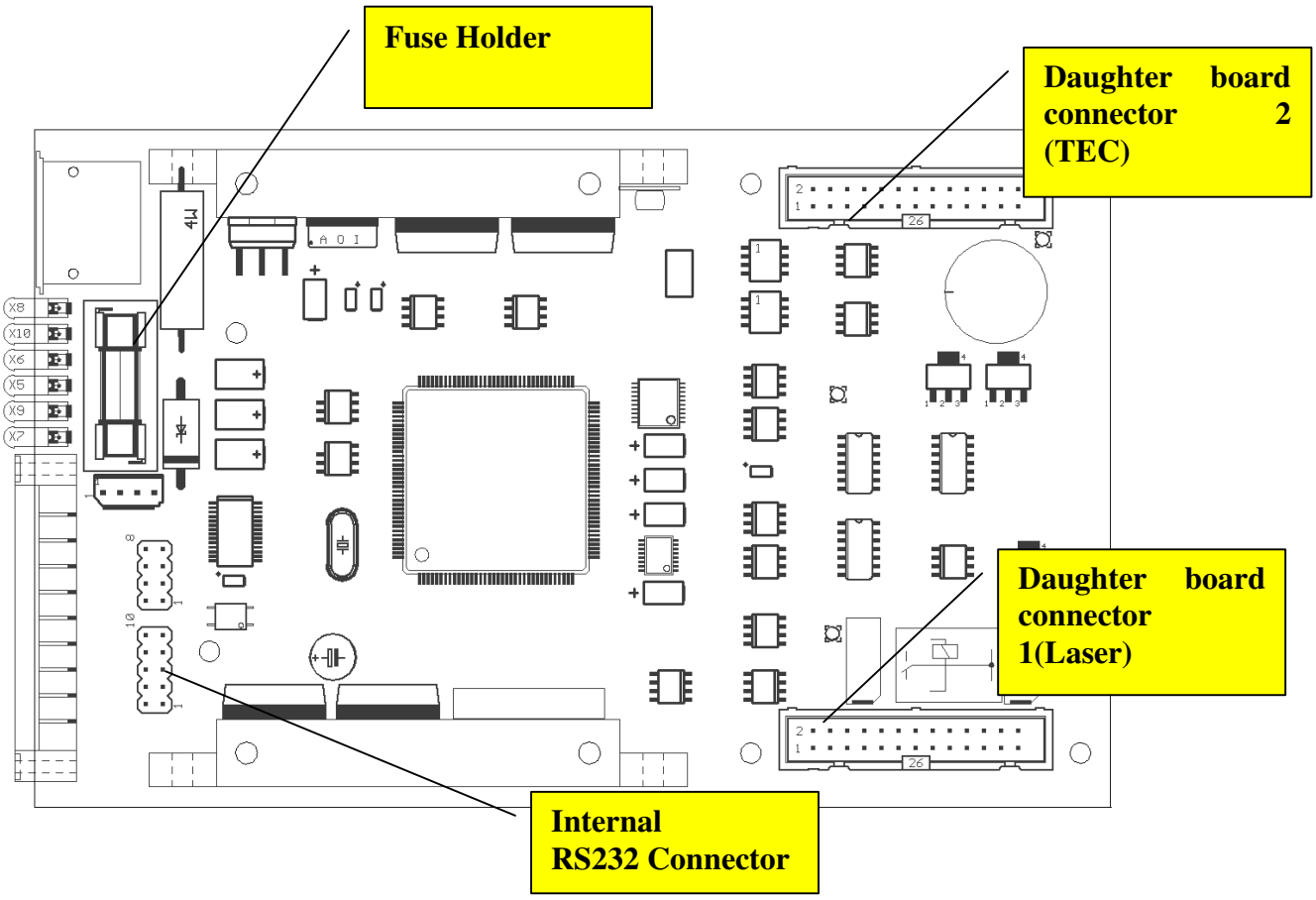


Pin 1:	NTC
Pin 2:	NTC
Pin 3:	LD Kathode Bias
Pin 4:	PD Anode
Pin 5:	PD Kathode
Pin 6:	Cooler +
Pin 7:	Cooler -
Pin 8:	Case Ground
Pin 9:	Case Ground
Pin 10:	n.c.
Pin 11:	LD Anode
Pin 12:	LD AC In
Pin 13:	LD Anode
Pin 14:	n.c.

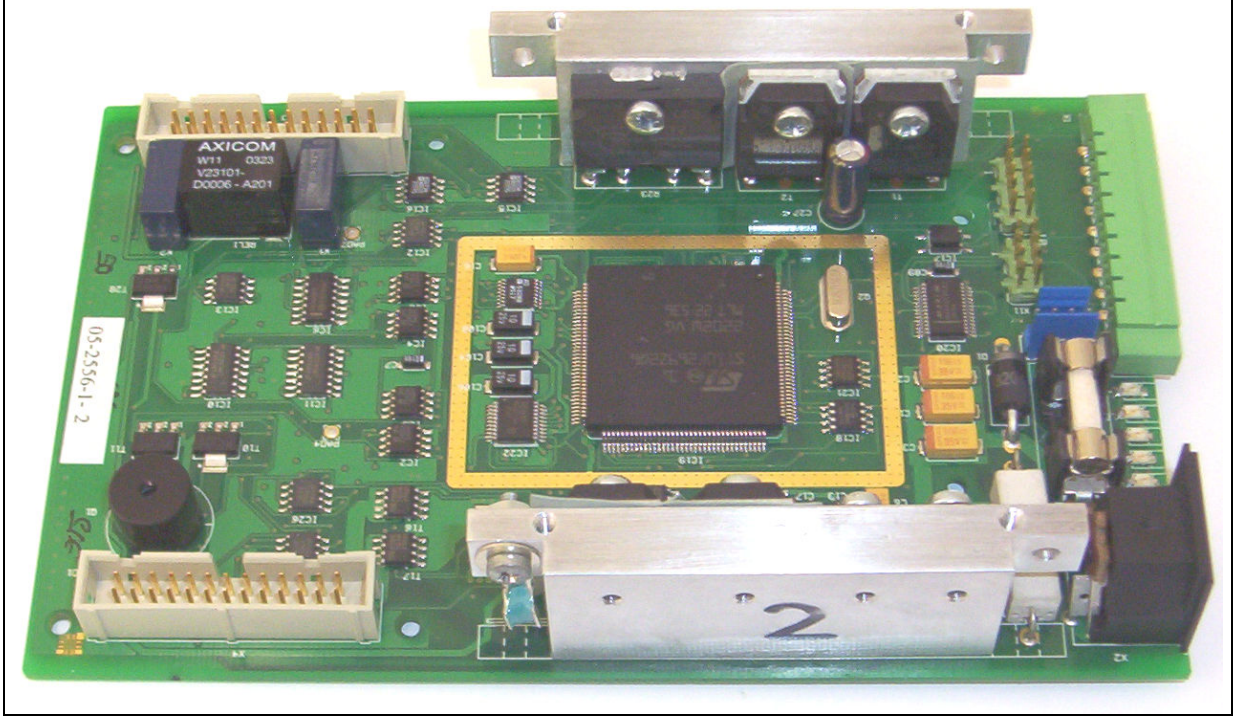
The following schematic shows the internal connection to the laserdiode

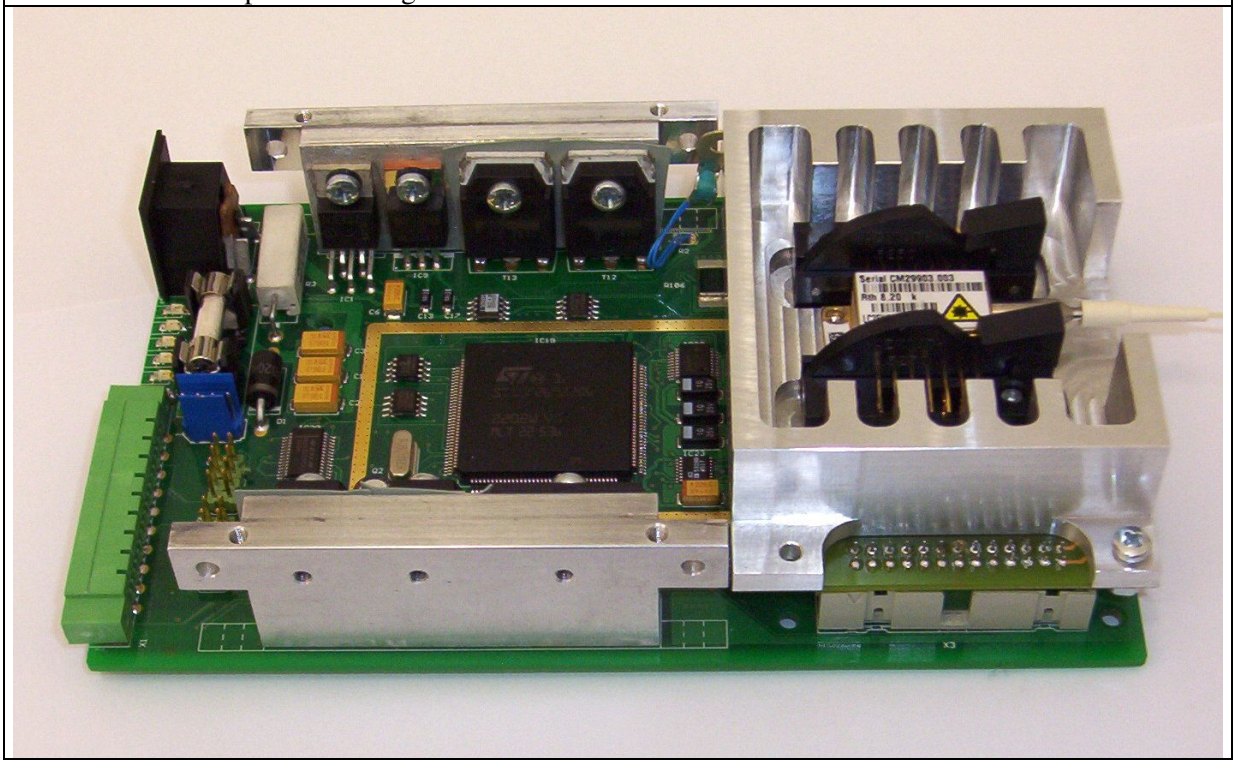


PilotPC-OEM Main Board Overview

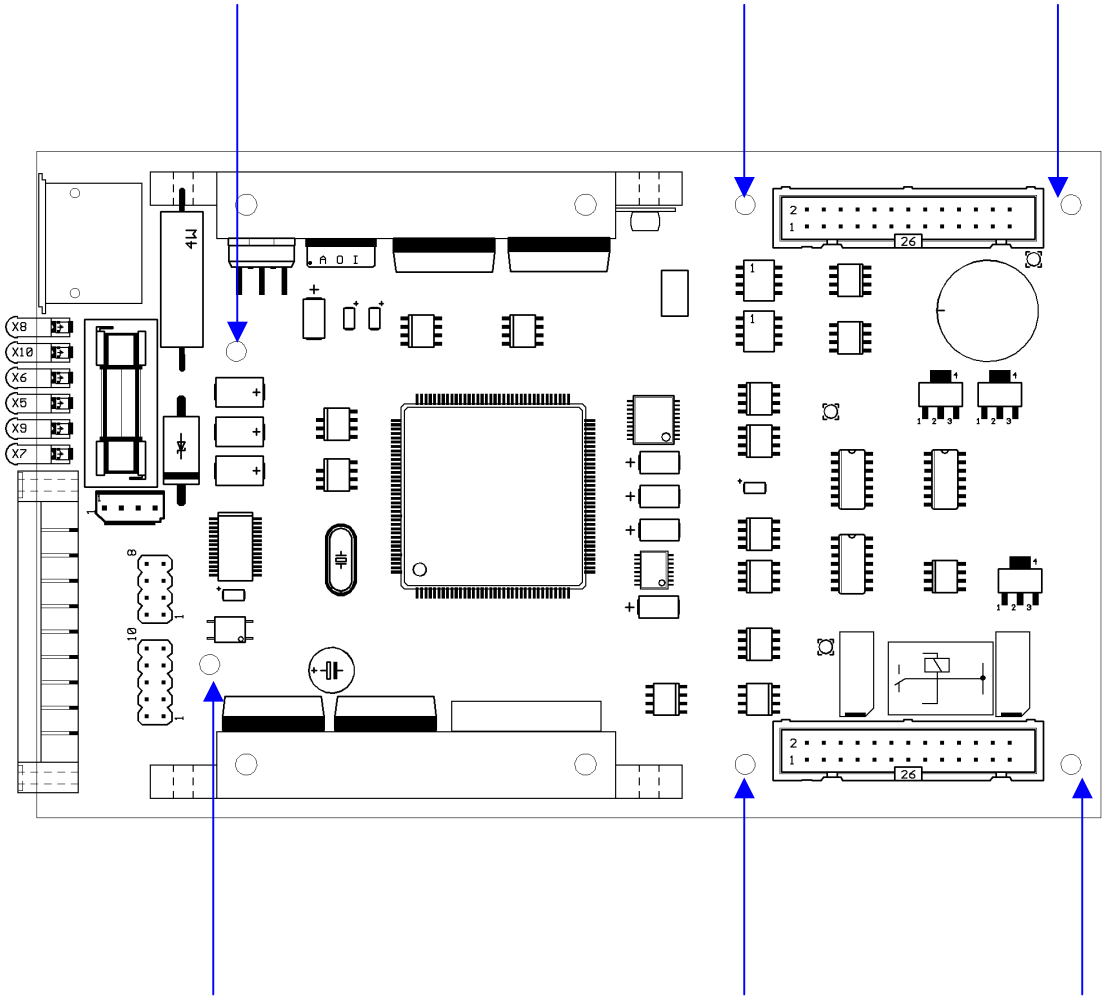


Board Pictures

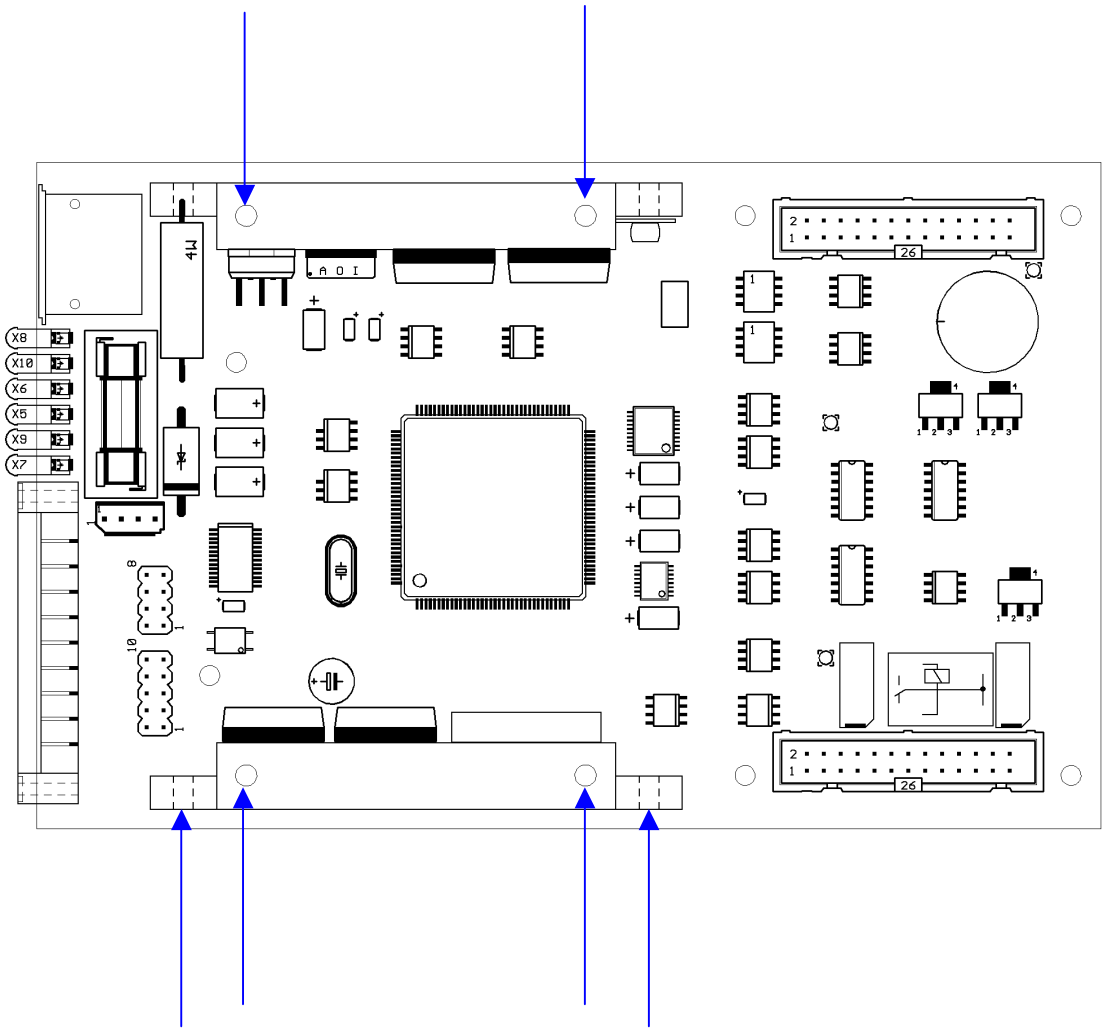
OEM Driver without Adapter Board


OEM Driver with opened housing rear view


Board Mounting Holes



Heatsink Mounting Holes



Error Codes

The onboard diagnostic module returns the system status and error flags. The error number is generated by the sum of each individual error number.
The bits are octal coded (refer to Table 4).

The following table explains the error origin.

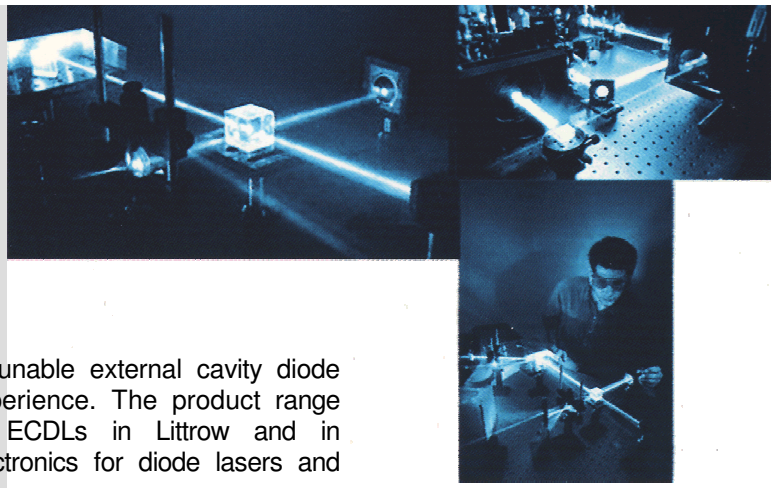
	Bit #	weight	Status / Error
Laser	0	1	I-Limit reached
	1	2	Laser Open Load / Compliance Voltage to low
	2	4	Error Laser requires TEC enabled
TEC	3	10	Temp Watch Out Of Window
	4	20	Temperature Out Of Range
	5	40	Temperature Not Reached
Range	6	100	Modulation Voltage Out Of Range
	7	200	Photo Diode Out Of Range
	8	400	Piezo Voltage Out Of Range
Loop	9	1000	Laser Head Loop Open
	10	2000	Extern Interlock Loop Open
	11	4000	Tec Loop Open
Device	12	10000	Remote Control Command Error
	13	20000	x
	14	40000	Device Over Temperature

Technical Support

Information and advice about the performance or operation of your laser is available from our application engineers. For quickest response ask for “Technical Support” and have your model and serial number available. Support is available by:

Sacher – Lasertechnik[Group]
Rudolf-Breitscheid-Str. 1-5
35037 Marburg, Germany
Tel: +49 6421 305 – 290, Fax: +49 6421 305 - 299
Contact@sacher-laser.com
or
5765 Equador Way
Buena Park, CA 90620
USA
Tel.: +1 800 352 3639, Fax: +1 714 670 7662

http://www.sacher-laser.com



Company Profile

Sacher Lasertechnik is leading manufacturer of tunable external cavity diode lasers (ECDLs) with more than 10 years of experience. The product range includes anti-reflection coated diode lasers, ECDLs in Littrow and in Littman/Metcalf configuration as well as driver electronics for diode lasers and sophisticated measuring electronics.

Sacher Lasertechnik was founded as a spin-off company of Marburg University in 1992. We started up with the manufacturing of anti-reflection coatings for diode lasers according to patent 6,297,066. Based an this key knowledge, we developed stable, narrow linewidth, wavelength tunable laser sources for spectroscopy, patent 5,867,512. We gratefully acknowledge the Support of the German ministry of research within contracts 1 3N6693 and13N7156.

Our product range currently covers

- Diode Lasers, Fabry Perot, DFB, Antireflection coated
- Tunable diode lasers in Littrow configuration
- Tunable diode lasers in Littman / Metcalf configuration
- High power (P>300mW) Raman lasers in Littrow configuration
- Low noise diode laser Controllers
- Measurement electronics

Please contact us with your measurement requirements. We would be proud to Support you with our competence.

Dr. Joachim R. Sacher

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5765 Equador Way
Buena Park, CA 90620
USA

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Rudolf-Breitscheid-Str. 1-5
35037 Marburg
Germany

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